# AMBIENT IMPACT ANALYSIS GUIDELINE

# CONNECTICUT DEPARTMENT OF ENVIRONMENTAL PROTECTION BUREAU OF AIR MANAGEMENT

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#### 1.0 INTRODUCTION

The Connecticut Department of Environmental Protection, Air Compliance Unit has prepared this document to provide guidance to applicants for air quality permits or other State or Federal orders which require ambient impact analyses.

#### 1.1 BACKGROUND/OBJECTIVES

The Clean Air Act (CAA) as amended in 1977 mandated that air quality modeling be used as a tool to asses compliance with certain provisions of the Act. These provisions include attainment and maintenance of national Ambient Air Quality Standards (NAAQS) and prevention of Significant Deterioration (PSD) of air quality.

Congress authorized the Environmental Protection Agency (EPA) to develop regulations to carry out the CAA provisions, and to delegate review authority to the States when a state program is at least as stringent as the federal program. The Connecticut Department of Environmental Protection (DEP) has developed regulations for the abatement of air pollution (CTDEP, 1988a) and has been delegated authority to carry out the federal requirements.

Air Quality modeling is the mathematical simulation of pollutant transport and dispersion in the atmosphere to estimate existing or potential future air quality levels at any desired location. Monitoring of air quality is normally only performed at a fixed location(s) for a limited duration. Modeling, therefore, complements monitoring by filling in information gaps in space and time.

EPA's Guideline on Air Quality models (EPA, 1986) describes numerous models and modeling procedures that can be used when assessing air quality. EPA's guideline addresses a broad range of modeling concerns such as what models, input data and technical considerations are appropriate for assessing impacts from mobile sources, stationary sources, photochemical processes and long range transport. DEP follows EPA's recommendations when performing air quality modeling. It should be noted that the EPA guideline and EPA models are occasionally revised or updated. Therefore the applicant should check with the DEP and incorporate any relevant changes.

The purpose of DEP's Ambient Impact Analysis Guideline (AIAG) is to promote consistency in the modeling procedures used to assess impact from stationary sources of air pollution in Connecticut, in a manner that conforms with EPA's modeling guidance. The AIAG modeling procedures are appropriate for non-reactive pollutants emitted by stationary sources. Other modeling applications (i.e., carbon monoxide from mobile sources, ozone photochemistry, visibility degradation, long range transport, etc.) should defer to EPA's modeling guideline (EPA, 1986).

#### 1.2 SUMMARY/OVERVIEW

The Connecticut Regulations for the Abatement of Air Pollution (CTDEP, 1988a; hereinafter, the Regulations) require stationary sources of air pollution to be registered through the DEP. Permits to construct are required for new sources and modifications to existing sources. Larger sources (with, for example, potential emissions exceeding 15 tons/year of sulfur dioxide) must estimate air quality impacts through the application of dispersion models. The AIAG was developed to assist permit applicants in conducting modeling analyses by recommending procedures that could be applied consistently in Connecticut while conforming with EPA's modeling guidance.

Many of the terms used in the Regulations and in this document have very explicit meanings. Actual emissions, allowable emissions, potential emissions, dispersion technique, good engineering practice stack height, major modification and other selected definitions from the Regulations are provided in Section 2.

In Section 3, air quality modeling issues are addressed, air quality standards are presented and the three models used routinely for permitting in Connecticut are described. Some of the recommended screening modeling can be performed with hand calculations to determine good engineering practice stack heights and the potential for adverse building downwash effects. The model ISCST is applied at receptor locations in simple terrain, while PTMTPA-CONN is used when terrain exceeds stack height.

The protocol followed by DEP in reviewing air quality modeling analyses is described in Section 4. The procedure is basically a three step process that includes a screening

assessment, single-source modeling of the subject source, and multiple-source modeling to include the effects of other nearby sources which contribute to the total pollutant loading of the atmosphere. A checklist (Appendix B) is used by DEP in reviewing modeling studies performed by permit applicants.

Model results are dependent on user-supplied input data to characterize the source of emissions, meteorology, receptor geometry and background air quality. The models also allow the user to specify various technical options relating to the specific application being simulate. Recommendations on the preparation and use of model input data and interpretation of results are provided in Section 5.

A list of referenced literature is provided in Section 6. Three appendices provide additional information needed to perform an ambient impact analysis. Appendix A is the "Protocol for Performing an Air Quality Modeling Analysis in Support of a DEP Construction or Operating Permit Application." Appendix B contains the Associated checklist used by DEP in reviewing modeling submittals, and Appendix C is a copy of EPA's building downwash screening procedures.

#### 2.0 DEFINITIONS

The definitions provided in this section apply to terms referred to by DEP in the implementation of its air pollution programs. In order to assist the reader, the definitions in this section are somewhat modified from the formal definitions in Section 22a-174-1 of the Regulations (CTDEP, 1988a). Where any differences exist, the definitions found in the Regulations take legal precedence.

#### 2.1 ACTUAL EMISSIONS

"Actual emissions" means the rate of emissions from a source, including fugitive emissions quantified by permit order or by registration information, after application of air pollution control equipment, of a particular air pollutant where the rate of emissions is calculated using:

- (A) real or expected production rates, hours of operation, and types of materials processed stored or combusted for the period specified; and
- (B) information from the "Compilation of Air Pollutant Emission Factors," AP-42, published by the U.S. Environmental Protection Agency, relevant source test data or other information deemed more representative by the Commissioner.

The Commissioner shall determine the actual emissions of a stationary source over the two (2) year period prior to the date of an application under the Regulations. The Commissioner may allow the use of another period which is deemed more representative, but in no event can it be before the design year of an applicable attainment plan.

For the purposes of the definition of actual emissions, if the Commissioner deems certain data or other information more representative, the Commissioner shall briefly state the reasons for such determination in writing. If an applicant seeks to have the Commissioner determine that certain data or other information is more representative, the burden of establishing that such data is more representative shall be on the applicant.

#### 2.2 AIR POLLUTANT

"Air pollutant" means dust, fumes, mist, smoke, other particulate matter, vapor, gas, aerosol, odorous substances, or any combination thereof, but does not include carbon dioxide, uncombined water vapor or water droplets, or molecular oxygen or nitrogen.

#### 2.3 ALLOWABLE EMISSIONS

"Allowable emissions" means the rate of emissions from a stationary source of a particular air pollutant where the emission rate is calculated using the maximum rated capacity of the source, unless the source is subject to permit conditions (or other order of the Commissioner) which limit the maximum rated capacity by restricting the operating rate, or hours of operation of the source and the most stringent of the following:

- (A) applicable standards as set forth in Title 40 of the Code of Federal Regulations Part 60 and Part 61, as from time to time may be amended;
- (B) the applicable emission limitation under the Regulations including those with a future compliance date; or

(C) the emission rate specified as a permit condition.

For the purpose of calculating allowable emissions, the emission limitation in (B) above, emission rate in (C) above and the permit conditions or other order of the Commissioner which limit the maximum rated capacity by restricting the operating rate or hours of operation of the source must be federally enforceable.

#### 2.4 AMBIENT AIR

"Ambient air" means that portion of the atmosphere external to buildings, to which the general public has access.

#### 2.5 AMBIENT AIR QUALITY STANDARD

"Ambient air quality standard" (AAQS) means any standard which establishes the largest allowable concentration of a specific pollutant in the ambient air of a region or subregion as established by the United States Environmental Protection Agency or by the Commissioner and which is listed in Section 22a-174-24 of the Regulations.

#### 2.6 COMMISSIONER

"Commissioner" means the Commissioner of Environmental Protection, or any member of the Department of Environmental Protection or any local air pollution control official or agency authorized by the Commissioner, acting singly or jointly, to whom provisions of these regulations.

#### 2.7 COMPLETE

"Complete" means, in reference to an application for a permit, that the application contains all the information necessary for processing the application. Designating an application complete for the purposes of permit processing does not preclude the department from requiring or accepting additional information.

#### 2.8 DIOXIN EMISSIONS

"Dioxin emissions" means tetrachlorodibenzodioxin (TCDD) and tetrachlorodibenzofuran (TCDF) emissions or emissions of any other isomers of comparable toxicity (see Section 22a-174-1 the Regulations, for a complete list).

#### 2.9 DISPERSION TECHNIQUE

"Dispersion technique" means any method which attempts to affect the concentration of a pollutant in the ambient air by:

- (A) using that portion of a stack which exceeds the good engineering practice stack height;
- (B) varying the rate of emission of a pollutant according to atmospheric conditions or ambient concentrations of that pollutant; or
- (C) increasing final exhaust gas plume rise by manipulating source process parameters, exhaust gas parameters, stack parameters or combining exhaust gases from several existing stacks into one stack or other selective handling of exhaust gas so as to increase the exhaust gas plume rise.

The preceding sentence does not include:

- (i) the reheating of a gas stream, following use of a pollution control system, for the purpose of returning the gas to the temperature at which it was originally discharged from the facility generating the gas stream;
- (ii) the merging of exhaust gas streams where: (aa) the owner or operator demonstrates that the facility was originally designed and constructed with such merged gas streams; or (bb) after July 8, 1985 such merging is part of a change in operation at the facility that includes the installation of pollution controls and is accompanied by a net reduction in the allowable emissions of a pollutant (This exclusion from the definition of dispersion technique applies only to the emission limitation for the pollutant affected by such change in operation); or (cc) before July 8, 1985 such merging was part of a change in operation at

the facility that included the installation of emissions control equipment or was carried out for sound economic or engineering reasons. Where there was an increase in the emission limitation or, in the event that no emission limitation was in existence prior to the merging, an increase in the quantity of pollutants actually emitted prior to the merging, the Commissioner shall presume that merging was significantly motivated by an intent to gain emissions credit for greater dispersion. Absent a demonstration by the source owner or operator that the merging was not significantly motivated by such intent, the Commissioner shall deny credit for the effect of such merging in calculating the allowable emissions of the source;

- (iii) smoke management in agricultural or silvacultural prescribed burning programs;
- (iv) episodic restrictions on residential wood burning and open burning; or
- (v) techniques under part C of this definition which increase final exhaust gas plume rise where the resulting allowable emissions of sulfur dioxide do not exceed five thousand (5,000) tons per year.

#### 2.10 EMISISON

"Emission" means the act of releasing or discharging air pollutants into the ambient air from any source.

#### 2.11 GOOD ENGINEERING PRACTICE

"Good engineering practice" (GEP) stack height means the greater of:

- (A) 65 meters, measured from the ground-level elevation at the base of the stack;
- (B) (i) for stacks in existence on January 12, 1979, and for which the owner or operator had obtained all applicable permits or approvals required under 40 CFR Parts 51 and 52,

provided the owner or operator produces evidence that this equation was actually relied on in designing the stack or establishing an emission limitation to ensure protection against downwash;

(ii) for all other stacks,

$$H_{\alpha} = H + 1.5L$$

where:

 $H_g$  = good engineering practice stack height, measured from the ground-level elevation at the base of the stack.

H = height of nearby structure(s) measured from the ground-level elevation at the base of the stack.

L = lesser dimension, height or projected width, of nearby
structure(s); or

(C) the height demonstrated by a fluid model or a field study approved by the EPA, state or local control agency, which ensures that the emissions from a stack do not result in excessive concentrations of any air pollutant (see 40 CFR 51.1 (kk)) as a result of atmospheric downwash, wakes, or eddy effects created by the source itself, nearby structure or nearby terrain features.

#### 2.12 MAJOR MODIFICATION

"Major modification" means a physical change, or change in the method of operation of a major stationary source, which would result in an increase in potential emissions of any individual air pollutant, which is equal to or greater than the amount listed in Table 3 (k) - 1 in Section 22a-174-3 of the Regulations. For the purposes of this definition:

- (A) a major stationary source of volatile organic compounds shall be considered a major stationary source for ozone; and
- (B) in calculating potential emissions, any physical or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment, or restrictions on production rates, hours of operation, types of materials processed, stored or combusted which limit the maximum rated capacity shall be treated as part of its design if the limitation, or the effect the limitation would have on emissions, is federally enforceable.

#### 2.13 MAJOR STATIONARY SOURCE

"Major stationary source" means:

- (A) a premise with potential emissions equal to or greater than one hundred (100) tons per year of any individual air pollutant prior to the application for a modification to that stationary source or addition to the premise; or
- (B) a premise with potential emissions equal to or greater than one hundred (100) tons per year of any individual air pollutant after taking into consideration:
  - (i) any increase in potential emissions of fifteen (15) tons per year or more from a proposed modification or the addition of a proposed stationary source; and
  - (ii) any other increases and decreases in potential emissions which the Commissioner determines will occur before the date that the increase from the proposed modification occurs; or
- (C) a physical change or change in the method of operation of a premise which in and of itself has potential emissions greater than or equal to one hundred (100) tons per year of any individual air pollutant; and
- (D) for the purposes of this definition:
  - (i) a "major stationary source" of volatile organic compounds shall be considered a "major stationary source" for ozone; and
  - (ii) in calculating potential emissions any physical or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment, or restrictions on production rates, hours of operation, and types of materials processed, stored or combusted which limit the maximum rated capacity shall be treated as part of its design if the limitation, or the effect the limitation would have on emissions, is federally enforceable.

#### 2.14 MAXIMUM RATED CAPACITY

"Maximum rated capacity" means the design maximum hourly capacity or highest demonstrated hourly capacity, whichever is greater, multiplied by 365 days per year and 24 hours per day.

# 2.15 MODIFY OR MODIFICATION

"Modify" or "modification" means making any physical change in, change in the method of operation of, or addition to a stationary source which:

- (A) increases the potential emissions of any individual air pollutant from a stationary source by five (5) tons per year or more; or
- (B) increases the maximum rated capacity of the stationary source unless the owner or operator of the stationary source demonstrates to the Commissioner's satisfaction that such increase is less than fifteen percent (15%) and the change or addition does not cause an increase in the actual emissions or the potential emissions; or
- (C) increases the potential emissions above the levels listed in Table 3 (k) 1 of subsection 22a-174-3 (k) of t the Regulations for the applicable air pollutants fluorides to beryllium inclusive; or
- (D) increases the potential emissions of any air pollutant which is federally regulated under the Clean Air Act and which is not listed in Table 3 (k) 1 of subsection 22a-174-3 (k) of the Regulations; or
- (E) increases maximum uncontrolled emissions from a stationary source by one hundred (100) tons per year or more.

In addition, a change in the type of fuel used in accordance with a permit or order, or the type of fuel for which the source has provided registration under Section 22a-174-2 to the Commissioner shall be considered a modification, unless such change is allowed under a permit or other order of the Commissioner (either of which is federally enforceable).

Notwithstanding the above, the following are not modifications unless the stationary source was previously limited by permit conditions or other order of the Commissioner:

- (i) any routine maintenance, repair, or replacement unless such replacement results in reconstruction as defined in the regulations; or
- (ii) a change in the method of operation; or
- (iii) any increase in the production rate, if such increase does not exceed the operating design capacity of the affected facility; or
- (iv) any increase in hours of operation; or
- (v) any change, the sole purpose of which is to bring an existing source into compliance with regulations applicable to such source; or
- (vi) relocation of a portable rock crusher with potential emissions of less than fifteen (15) tons per year which has a permit or exception letter issued by the Commissioner under Section 22a-174-3 of the Regulations, provided the owner or operator provides written notice to the Commissioner prior to the relocation.

#### 2.16 NEARBY

"Nearby" as used in the definition of GEP stack height is defined for a specific structure or terrain feature and

- (A) for the purpose of applying the GEP formulae, means that distance which is up to five times the lesser of the height or the width dimension of a structure, but not greater than 0.8 km (0.5 mile), and
- (B) for conducting fluid model or field study demonstrations of GEP stack height, means not greater than 0.8 km (0.5 mile), except that the portion of a terrain feature may be considered to be nearby which falls within a distance of up to 10 tames the maximum height (H) of the feature, not to exceed 3.2 km (2 miles) if such feature achieves a height 0.8 km (0.5 mile) from the stack that is greater

than or equal to 40 percent of the GEP stack height determined by the formulae or 26 meters, whichever is greater, as measured from the ground-level elevation at the base of the stack.

#### 2.17 PARTICULATE MATTER

"Particulate matter" means any material, except water in uncombined form, that is or has been airborne and exists as a liquid or a solid at standard conditions.

#### 2.18 PM<sub>10</sub>

"PM $_{10}$ " means particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers as measured by a reference method based on appendix J of Title 40 Code of Federal Regulations Part 50 and designated in accordance with Title 40 Code of Federal Regulations Part 53 as published in the July 1, 1987 Federal Register or by an equivalent method approved by the EPA administrator in accordance with Title 40 Code of Federal Regulations Part 53.

#### 2.19 POTENTIAL EMISSIONS

"Potential emissions" means the rate of emissions from a stationary source (including fugitive emissions to the extent quantified by permit order or by registration information, after application of air pollution control equipment) of a particular air pollutant such that the rate is equal to or greater than the actual emissions and where the rate of emissions is calculated using:

- (A) the maximum rated capacity of the stationary source, unless the maximum rated capacity is limited by restrictions on production rates, hours of operation and types of materials processed, stored or combusted either through permit conditions or other order of the Commissioner; and
- (B) information from the "Compilation of Air Pollutant Emission Factors," AP-42, published by the U.S. Environmental Protection Agency, relevant source test data or other information deemed more representative by the Commissioner.

In calculating potential emissions, any physical or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment, or restrictions on production rates, hours of operation, and types of materials processed, stored or combusted which limit the maximum rated capacity shall be treated as part of its design if the limitation, or the effect the limitation would have on emissions, is federally enforceable.

#### 2.20 PREMISE

"Premise" means the grouping of all stationary sources at any one location and owned by, or under the control of, the same person or persons.

#### 2.21 SOURCE

"Source" means any property, real or personal, which emits or may emit any air pollutant.

#### 2.22 STACK

"Stack" means any point of release from a source which emits solids, liquids, or gases into the ambient air (including a pipe, duct or flare).

#### 2.23 STATIONARY SOURCE

"Stationary source" means any building, structure, facility, equipment, operation or installation which is located on one or more contiguous or adjacent properties and which is owned, or operated by the same person, or by persons under common control, which emits or may emit any air pollutant and which does not move from location to location during normal operation (except that portable rock crushers which are moved from site to site, but remain stationary during operation and asphalt plants which combine aggregate and asphalt while in motion are considered stationary sources).

#### 2.24 TOTAL SUSPENDED PARTICULATE

"Total suspended particulate" means particulate matter as measured by the method described in Appendix B of Title 40 Code of Federal Regulations Part 50.

#### 3.0 SCOPE OF AIR QUALITY MODELING

Air quality modeling is the mathematical simulation of pollutant transport and dispersion in the atmosphere to estimate existing or potential air quality levels. Unlike monitoring, which can assess air quality at only a limited number of discrete locations, models can be used to estimate air quality over a large gird of receptors. Modeling is also used as a planning tool to estimate future air quality changes that might occur from changes in source emissions.

In this section, some fundamental modeling concepts are presented, air quality standards which must be complied with are listed and the models used by DEP are summarized. Specific recommendations for applying air quality models in Connecticut are provided in Section 5.

#### 3.1 MODELING CONCEPTS

Air quality levels in the vicinity of stationary sources are dependent on many physical processes which the air quality models recommended by EPA and used by DEP attempt to simulate. These processes depend on meteorology, source characteristics, background air quality levels and location.

Meterological factors are used to characterize direction of plume transport and rate of dispersion after pollutants are emitted from a source. The meteorological factors required by most models include hourly estimates of wind speed, wind direction, temperature, atmospheric stability and mixing depth.

Source characteristics are needed for the source under investigation as well as other nearby sources that could signficantly impact air quality levels at the locations of interest. Source characteristics include location, pollutant emission rate, stack parameters and nearby building dimensions. Stack parameters are defined by stack height, stack gas temperature and volumetric flow rate as needed to calculate plume rise, while nearby building dimensions are used to estimate GEP stack height and the potential for building downwash. Specific input requirements are listed in Section 5.

Background air quality can be thought of as the air quality that would exist in the absence of influences from the modeled local sources. It is composed of air pollutants from area-wide

sources, natural sources and transport from distant locations without definable single source contributions. Background air quality levels are dependent on meteorological factors and tend to increase during atmospheric stagnation conditions. Modeled impacts from point sources are added to background levels to assess compliance with ambient air quality standards.

Geographic location is simulated several ways in an air quality model. Receptor locations are used to define points in space (horizontally and vertically) where model predictions are made. Depending on horizontal wind direction for any given hour of simulation, the plume from a source may or may not impact a given receptor. The geometry of source locations also comes into play when several sources are being modeled. Maximum impacts are more likely to occur when a receptor is downwind from several sources, rather than when just one source is involved.

Location, such as urban or rural, is also a factor in determining the turbulence-generating surface roughness. In urban locations plumes are assumed to disperse more quickly than in rural areas. In complex terrain, plume heights relative to ground level are often reduced, resulting in higher concentrations on elevated terrain.

#### 3.2 AIR QUALITY CRITERIA

#### 3.2.1 AMBIENT AIR QUALITY STANDARDS

National and State ambient air quality standards (AAQS) have been established for the criteria air pollutants as shown in Table 3-1. Each AAQS is defined in terms of pollutant, averaging time and level above which health is at risk (primary standard) or materials damage could occur (secondary standard). Short-term standards (averaging time up to 24 hours) generally should not be exceeded more than once per year, although the ozone standard is defined as a level not to be exceeded more than an average of once per year in three years. Long-term standards (quarterly and annual) should never be exceeded.

Modeled compliance with each AAQS is determined by adding background levels (for the appropriate pollutant and averaging time) to modeled levels and comparing the highest value (from the set of receptors modeled) to the AAQS. For short-term averages the modeled impact is added to background levels and

the highest of the second high values (at each receptor) is compared to the AAQS. The modeled levels used in this determination represent impacts not only from the applicant source, but also other nearby sources (this data is provided by DEP), plus background levels (also provided by DEP, unless monitoring is required).

TABLE 3-1
CONNECTICUT AND NATIONAL AMBIENT AIR QUALITY STANDARDS

POLLUTANT	AVERAGING TIME	PRIMARY STANDARD		SECONDARY STANDARD	Y
		ug/m³	ppm	ug/m³	ppm
Carbon Monoxide	8-Hour Average <sup>1</sup>	10,000	9	SAN	<sub>ME</sub> 2
	1-Hour Average <sup>1</sup>	40,000	35	SAN	ΜE
Dioxins	Annual Average	1x10 <sup>-6</sup>		SAN	ΜE
Hydrocarbons	3-Hour Average <sup>1,3</sup> (6-9 am)	160		SAN	ΜE
Lead	3-Month Average	1.5		SAN	/IE
Nitrogen Dioxide	Annual Average	100	0.05	SAN	4E
Ozone	1-Hour Average <sup>4</sup>	235	0.12	SAN	ИЕ
Particulate					
Matter:					
TSP	Annual Geometric Mean	75		60 <sup>5</sup>	
	24-Hour Average <sup>1</sup>	260		150 -	- <del></del>
PM10	Annual Arithmetic Mean6	50		50 -	- <del></del>
	24-Hour Average <sup>4</sup>	150		150 -	
Sulfur Dioxide	Annual Average	80	0.03		
	24-Hour Average <sup>1</sup>	365	0.14		
	3-Hour Average <sup>1</sup>			1300	0.50

<sup>&</sup>lt;sup>1</sup>Not to be exceeded more than once per year.

Units:  $ug/m^3 = micrograms$  per cubic meter; ppm = parts per million.

<sup>&</sup>lt;sup>2</sup>Same as primary standard.

 $<sup>^{3}</sup>$ For use as a guide in implementation plans to achieve the (former) 0.08 ppm ozone standard.

 $<sup>\</sup>overline{{}^{4}}$ Not to be exceeded more that an average of once per yr. in 3 yrs.

<sup>&</sup>lt;sup>5</sup>A guide to be used in SIP's plans to achieve the 24-hour standard.

 $<sup>^6</sup>$ This is an expected annual value (see 40CFR, Part 50, Appendix K).

#### 3.2.2 PREVENTION OF SIGNIFICANT DETERIORATION

The prevention of significant deterioration (PSD) regulations protect air quality levels that are cleaner than the AAQS by not allowing significant incremental degradation above baseline concentrations (see Federal Register Notices: August 7, 1980, Vol. 45, p. 52676 for TSP and  $SO_2$  PSD rules after Alabama Power; and October 17, 1988, Vol. 53, p. 40656 for  $NO_x$  PSD rules). PSD increments (shown in Table 3-2) have been promulgated for particulate matter, sulfur dioxide and nitrogen dioxide. Baseline concentrations are essentially the ambient concentration levels of the particular air pollutant in existence at the time of the first PSD permit application submittal affecting an area.

DEP maintains PSD inventories for each pollutant for the purpose of tracking PSD increment consumption (and expansion). An applicant must assess PSD increment consumption from the subject source as well as from the inventory of nearby PSD sources (which DEP will provide once the significant impact area of the applicant source is determined, see Section 5).

#### 3.2.3 SIGNIFICANT IMPACTS

Modeled impacts from a source of air pollution are considered significant if they equal or exceed the values listed in Table 3-3. These levels are used to determine if a source causes or contributes significantly to a violation of the NAAQS or PSD increments. Significant impacts should not be confused with the PSD increments.

#### 3.3 MODELS USED BY DEP

EPA's modeling guideline (EPA, 1986) was used by DEP to develop a modeling procedure that can be used consistently to assess ambient impacts of stationary sources of air pollutants in Connecticut. EPA's guideline should be used to select additional models for addressing regulatory concerns such as visibility degradation, mobile source impacts, reactive plumes and long range transport.

Three different models are needed to adequately address most situations which are encountered in Connecticut: 1) EPA's screening methodology for building downwash/cavity zone impacts; 2) ISCST, a general purpose refined mode; and 3) PTMTPA-CONN for complex terrain. These models are discussed in more detail below.

TABLE 3-2

PREVENTION OF SIGNIFICANT DETERIORATION INCREMENTS

(MAXIMUM ALLOWABLE INCREAST ABOVE BASELINE CONCENTRATION)

POLLUTANT	PSD INCREMENT (ug/m <sup>3</sup> )		
Particulate Matter (TSP)			
Annual Geometric Mean	19		
24-Hour Average <sup>1</sup>	37		
Sulfur Dioxide			
Annual Arithmetic Mean	20		
24-Hour Average	91		
3-Hour Average <sup>1</sup>	512		
Nitrogen Dioxide			
Annual Arithmetic Mean	25		

 $<sup>^{1}\</sup>mbox{Not}$  to be exceeded more than once per year

TABLE 3-3
SIGNIFICANCE<sup>1</sup> LEVELS FOR STATIONARY SOURCES

POLLUTANT	AMBIENT IMPACT (ug/m³)
Particulate Matter (TSP or PM10)	
Annual Average 24-Hour Average	1 5
Sulfur Dioxide	
Annual Average 24-Hour Average 3-Hour Average	1 5 25
Carbon Monoxide	
8-Hour Average 1-Hour Average	500 2000
Nitrogen Dioxide	
Annual Average	1
Hazardous Pollutants <sup>2</sup>	
In Table 29-1 of the Regula In Table 29-2 of the Regula In Table 29-3 of the Regula	tions 10% of AAQS

 $<sup>^1\</sup>mathrm{Source}$  impacts must be less than the appropriate significance levels to be considered "insignificant".

 $<sup>^2</sup>$ Note that significance levels for hazardous pollutants are defined as a percentage of the standard (as defined in the Regulations).

# 3.3.1 BUILDING DOWNWASH/CAVITY ZONE MODEL

EPA's Guideline for the determination of GEP stack height (EPA, 1985) is the recommended procedure to assess whether emissions from a stack will be influenced by the turbulent wake zones created by nearby buildings or terrain. The procedure is fairly simple and is performed with hand calculations.

If a stack is found to be subject to building downwash (i.e., stack height less than GEP), then the controlling building dimensions should be entered as input into the refined models. In addition, further calculations should be performed to determine if the stack effluent will be recirculated into the part of the building wake known as the cavity zone. If cavity zone recirculation is likely, calculations can then be made to estimate maximum cavity zone concentrations. The entire procedure was recommended by EPA in a regional workshop summary report (EPA, 1981; amended in 1983) and is reproduced here as Appendix C.

#### 3.3.2 INDUSTRIAL SOURCE COMPLEX DISPERSION MODEL

The short term version of the Industrial Source Complex (ISCST) model (EPA, 1987a) is a multi-purpose dispersion model recommended for a broad range of regulatory applications. The model and user's guide are available as part of EPA's User's Network of Applied Models for Air Pollution (UNAMAP) Version 6, through the National Technical Information Service, Springfield, VA (tel. 703-487-4650). PC versions of the model are also available through EPA's UNAMAP Bulletin Board and private consulting firms. Changes and updates are occasionally made to the ISCST model, therefore applicants should consult the DEP to ensure that the most recent EPA-approved version will be used.

ISCST is a Gaussian plume model which can be used as a screening tool or as a refined model to estimate one hour to annual average concentrations. It can simultaneously process a multitude of point, area or volume sources, while using up to one year of hourly meteorological data to calculate concentrations at a large array of gridded and discrete receptor locations.

Through user specifications, ISCST can be configured to account for urban vs. rural dispersion characteristics, final or transitional plume rise, building downwash, stack tip downwash, buoyancy-induced dispersion, settling and deposition of particulate matter and limited terrain adjustment.

ISCST is not designed for refined treatment of terrain elevations greater than physical stack height. The model automatically truncates terrain elevations at the physical stack height (less 0.005 meters) for each stack modeled. A more complete treatment of these receptors requires additional modeling with PTMTPA-CONN.

Detailed DEP recommendations for the selection of ISCST technical options, source data, meteorology, receptors, background concentrations and interpretation of results can be found in Section 5.

#### 3.3.3 PTMTPA-CONN

PTMTPA-CONN (CTDEP, 1988a) is a multiple point-source Gaussian plume model used by DEP for assessing stationary source impacts in complex terrain (i.e., on terrain elevations that are higher than physical stack height). For complex terrain applications, PTMTPA-CONN is similar in many respects to EPA's Valley model (Burt, 1977) except that, rather than calculating sector-averaged concentrations, it assumes a Gaussian distribution in the horizontal. In this respect, it is more similar to COMPLEX II, EPA's recommended second-level screening technique in complex terrain.

In elevated terrain, stack heights are adjusted relative to the terrain heights. For stable conditions, PTMTPA-CONN uses full terrain subtraction from the effective stack height (with a minimum adjusted plume height of 10 meters). PTMTPA-CONN also adjusts plume heights (by the same full terrain subtraction method) during neutral and unstable conditions, but with a maximum adjustment of ½ of the unadjusted plume height.

A feature unique to the complex terrain screening mode of PTMTPA-CONN is the 24-hour average wind variability/persistence scheme. In this mode (KPRMT=1), the set of 17 meteorological conditions described in Section 5 should be entered as input data. For each meteorological condition, the model uses an

adjusted wind direction which places each receptor directly downwind of the first source (i.e., the source for which permit conditions are being tested). Average concentrations for each condition are then calculated for two schemes that allow wind direction to vary around the centerline by ±10 and ±15 degrees. An adjusted 24 hour average concentration is the calculated by assuming the stability class for each input meteorological condition can occur for 8 hours out of 24, while the remaining 16 hours are neutral (D-stability). The maximum adjusted 24-hour concentration is then selected for comparison with air quality standards and increments. As a consequence, the PTMTPA-CONN model is somewhat more restrictive than the Valley model and has been approved for use in Connecticut on SIP revisions and PSD permitting.

The PTMTPA-CONN model was developed by the DEP and can be obtained from the DEP Modeling Section by calling 203-566-2690. The purchase price is \$2000 for either the PC version (FORTRAN source code and PC executable code) on floppy diskette or the mainframe version (FORTRAN code only) on 9-track magnetic tape.

#### 4.0 DEP PROCEDURES FOR ASSESSING AMBIENT IMPACT

Air quality modeling is used by the DEP to assess the ambient pollutant levels that could occur from the operation of new or existing air pollution sources in Connecticut. The objective is to ensure that applicable air quality standards (Table 3-1) and PSD increments (Table 3-2) are not exceeded. In this section, DEP's protocol and checklist for reviewing modeling analyses will be summarized.

#### 4.1 OVERVIEW OF DEP PROTOCOL FOR AIR QUALITY MODELING

Any person who owns or operates a stationary source of air pollution (as defined in the Regulations) must register with the DEP. New sources, or modifications to existing sources, must additionally apply for a permit to construct. The "Protocol for Performing an Air Quality Modeling Analysis in Support a DEP Construction or Operating Permit Application" (see Appendix A) is intended to assist permit applicants who are required to perform air quality modeling to obtain a permit. The protocol consists of the following parts which are summarized below:

- Part 1. Preparation of application forms and emission calculations
- Part 2. Formulation of modeling protocol
- Part 3. Screening modeling
- Part 4. Single source modeling
- Part 5. Multi-source modeling
- Part 6. Analysis of results and report

Application preparation entails an engineering review of the source to estimate emissions of all air pollutants and to characterize where and how pollutants will be released to the atmosphere. The ambient impact of sources that are not subject to either DEP or EPA modeling requirements is assessed through a stack height screening test (CTDEP, 1979).

If the source is subject to modeling requirements by either DEP or EPA, the application is referred to the Technical Services Section of DEP's Air Compliance Unit. At this point, a meeting is recommended to familiarize the applicant with the appropriate air quality modeling procedures to be followed.

The screening modeling is performed to assess: 1) the potential for building downwash into the cavity zone, which can lead to elevated concentrations near a source, 2) worst case load conditions, and 3) receptor locations for subsequent refined modeling. EPA's building downwash screening procedures (EPA, 1981; revised in 1983) are reproduced here in Appendix C. The applicant's source should be modeled at a minimum of 50, 75 and 100% loads to determine if maximum impacts might occur at conditions other than full load. A receptor grid is designed at this point to ensure that the location of maximum impacts and distances of significant impact will be obtained from the refined modeling (see Section 5).

Refined modeling is performed for the subject source alone (i.e., single source modeling) using the recommended model inputs described in Section 5. From the single source modeling results, the applicant can determine the radius of significance for each pollutant (see Table 3-3). This information is then used in DEP's radius search for adjacent sources.

Modeling for multiple adjacent sources is performed to ensure that operation of the applicant's source will not result in exceedances of any AAQS or PSD increments. Two inventories, to assess compliance with AAQS and PSD increments, are provided by DEP (from the radius search program) for each pollutant, as described in Section 5.

Model input files and a report summarizing procedures and results are provided by the applicant to DEP for review. DEP reviews the submittal and prepares a summary report with recommendations for: 1) approval of the modeling (and operating conditions) as submitted; 2) approval of the modeling with restrictions; or 3) rejection of the modeling on technical grounds.

# 4.2 DEP CHECKLIST FOR REVIEWING PERMIT APPLICAIONS

As DEP reviews modeling submittals, a checklist is prepared (see Appendix B). Applicants are encouraged to make sure that the checklist information can be easily obtained from any reports submitted to DEP in order to expedite the review process. The checklist and associated tables of maximum modeled impacts become part of DEP's summary report.

# 5.0 GUIDANCE FOR MODEL INPUTS AND INTERPRETATION OF MODEL RESULTS

This section provides recommendations for model input data requirements as interpreted by DEP from EPA's modeling guideline (EPA, 1986). In general, EPA's recommendations are followed exactly, although DEP's recommendations may be more restrictive in selected cases. When situations arise where no DEP recommendations are available, applicants should refer to the appropriate model user's guide and/or the EPA modeling guideline, and then consult with DEP personnel.

#### 5.1 SELECTION OF MODEL CONTROLS AND OPTIONS

#### 5.1.1 GENERAL RECOMMENDATIONS

<u>Urban/Rural Designation</u>. The selection of an urban or rural designation should follow the land use classification described by Auer (1978). This methodology should be augmented by a population density-based procedure (EPA, 1986) when the land use analysis proves inconclusive (i.e., a 50-50 urban/rural split). The Land use classification and population density procedures are described below.

#### Land Use Classification

Classify the land use within the total area circumscribed by a 3 kilometer radius circle centered about the subject source. All areas contained in this circle that are shaded pink or purple on a recent USGS topographic map should be considered urban. All areas on the topographic map which are shaded green should be considered rural. Any areas in the circle which are not shaded pink or green should be matched to one of Auer's land use categories. The use of aerial photography may be helpful in making this determination.

If 50 percent or more of the land use is classified as urban (i.e., Auer categories I1, I2, C1, R2 or R3), designate the area urban; otherwise, designate the area rural.

#### Population Density Procedure

Due to the subjectivity involved in categorizing land use, the population density procedure may be used to augment the land use procedure. The population procedure requires the

computation of the average population density within the 3 km radius circle mentioned above. A population density greater than 750 people per square kilometer would support the rural designation.

Plume Rise. The plume rise equations developed by Briggs (see EPA, 1987a, for references) are used in all models mentioned in the guideline. DEP recommends the use of transitional (rather than final) plume rise if an option exists.

<u>Buoyancy-Induced Dispersion</u>. DEP recommends the use of buoyancy-induced dispersion (entertainment resulting from plume rise) whenever a model allows it.

Good Engineering Practice Stack Height. DEP recommends procedures described in the EPA's "Guideline for Determination of Good Engineering Practice Stack Height" (EPA, 1985) for GEP stack height calculations. In order to properly treat building downwash, a GEP stack height should be determined for each source to be modeled except those sources which lie outside the pollutant-specific radius of significance of the subject source. The lesser of actual or GEP stack height should be used for modeling each source.

<u>Building Downwash.</u> DEP recommends; 1) use of the ISC model (EPA, 1987a) for calculating downwash impacts for sources subject to building downwash; and 2) the screening procedures described in EPA's Regional Workshop document (EPA, 1981, revised in 1983) for calculating worst case impacts in the cavity zone of a structure. Building downwash effects need not to be considered for the modeling of additional sources located beyond them radius of significance of a subject source.

Wind Profile Exponents and Vertical Potential Temperature Gradient.

DEP recommends the use of default exponents and temperature
gradients used in the ISC model (EPA, 1987a), as shown in Table 5-1.

# 5.1.2 ISC Control Options

This section describes the switch settings and control options that are recommended by DEP for use with the ISCST modeling runs.

- ISW (1) = 1 Program calculates pollutant concentration (rather than deposition).
- ISW (2) = 4 Allows for a polar coordinate system, with program generated direction radials.
- - or 2 If discrete receptors are entered in polar Coordinates.
- ISW (4) = 1 Terrain elevations are read (for refined modeling).

TABLE 5-1

WIND-PROFILE EXPONENTS

AND

VERTICAL POTENTIAL TEMPERATURE GRADIENTS

Pasquill Stability Category	Urban Wind-Profile Exponent	Rural Wind-Profile Exponent	Vertical Potential Temperature Gradient (°K/M)
A	0.15	0.07	0.000
В	0.15	0.07	0.000
С	0.20	0.10	0.000
D	0.25	0.15	0.000
E	0.30	0.35	0.020
F	0.30	0.55	0.035

Elevations are not input (for screening runs). or 0 Concentrations need not be written to tape. ISW(5) = 0List all input data excluding meteorological ISW(6) =inputs. Switches 7 through 15 (averaging time options) ISW(7) =should be chosen such that pollutant concentrations are output for comparison with standards. For example, an SO, modeling run should set thru switches 9, 14, and 15 equal to 1 so that 3-hour, 24-hour and annual concentrations will be output. ISW(15) =ISW(16) =Daily tables need not be output. Highest and second highest tables should be ISW(17) =printed. Maximum 50 tables should be output. ISW(18) = 1Meteorological data is input as pre-processed ISW(19) =1 for refined modeling. Meteorological data is input in card format or 2 for screening modeling. If the source is determined to be in a rural ISW(20) = 0location. If the source is determined to be in an urban or 3 location. Wind profile exponent values should be set to ISW(21) =1 defaults. Vertical potential temperature gradient values ISW(22) =1 should be set to defaults. Scaled emission rates should not be used. ISW(23) =Plume rise should be calculated as a function ISW(24) =of downwind distance. Stack heights should be adjusted for downwash. ISW(25) =2 Buoyancy-induced dispersion should be used. ISW(26) =1 The calm wind processing option should be ISW(27) =1 used. The regulatory default option should not be ISW(28) =2 used.

The following values are recommended for other ISCST input variables:

- IPERD = 0Time period of interval printed, (default value = 0). Emission unit conversion factor, (this ΤK 0 produces the default value of 1x10°). Anemometer height, (this produces the default ZR= 0 value of 10 meters). ISS = 14740 Use these values with Bradley Airport = 14735 pre-processed meteorological data. IUS = 94702Use these values with Bridgeport ISS = 94789 pre-processed meteorological data. IUS 70 (71, 72, 73, or 74), depending upon the year IUY of meteorological data used.
- DECAY = 0 Infinite pollutant half-life (default value).
  or 0.0000481 If the pollutant is SO<sub>2</sub> and the source
  location is urban. This corresponds to a four
  hour half-life for SO<sub>2</sub>.

# 5.1.3 PTMTPA-CONN CONTROL OPTIONS

This section describes the control options that are recommended by DEP for use with the PTMTPA-CONN model when it is applied in complex terrain.

KNTRL = 2	For printing of total concentrations.
KTOP = 2	To select plan displacement and "STREAMFLOW".
KU = 1 height.	To select an exponential increase of wind speed with
KPRMT = 1	To select permit version.
NGLISH = 1 = 2	For source and receptor input: english units. For source and receptor input of metric units.
IBID = 1	To select buoyancy-induced dispersion.
IRURB = 1 = 2	For use in rural applications. For use in urban applications.

# 5.2 STATIONARY SOURCE DATA

# 5.2.1 SOURCE PARAMETERS

Air quality dispersion models require the following parameters to adequately characterize sources being modeled:

<u>Parameter</u>	Description
Emission rate	pollutant emissions (g/s)
X coordinate	source coordinate (CT grid ft)
Y coordinate	source coordinate (CT grid ft)
stack elevation	height (m) of stack base above mean Sea level
stack height	height of stack-top above stack base (m)
stack diameter	diameter at top of stack (m)

stack temperature temperature (°K) of effluent exiting the

stack

stack gas velocity velocity (m/s) of effluent exiting the

stack

HB and HW height and width of controlling building

used to simulate downwash.

### 5.2.2 SOURCES

For a subject source, all source parameters mentioned above should be available part of the permit application. In an AAQS analysis the subject source and all other stationary sources located on the subject premise are modeled with their allowable emission rates. For PSD increment tracking, the subject source and all increment consuming sources located on the applicant's premise are modeled with allowable emission rates.

For other existing AAQS sources and PSD increment consuming sources, the source parameters and emission rates will be provided by the DEP from their point source inventory in the following manner. Once the pollutant-specific radius of significance for the subject source has been determined, a radius search program will be run by the DEP to retrieve source parameters for the AAQS and PSD multi-source modeling analyses. Applicants are charged a fee of \$500 for the radius search plus \$10 for each source identified.

DEP's radius search program will retrieve the following sources for the pollutant requested:

#### I. For AAQS modeling

- (a) All stacks with actual emissions of  $\geq$  15 tons per year (TPY) of a given pollutant that lie within the radius of significance of the subject source for that pollutant..
- (b) All stacks with actual emissions of  $\geq$  50 TPY that lie within 20 kn of the subject source.
- (c) All stacks with actual emissions of  $\geq$  500 TPY that lie within 50 km of the subject source.

All sources retrieved above should be modeled at their allowable emission rates, except that sources from (a) and (b) which are not located on a major stationary source, should be modeled at their actual emission rates. The actual emission rates for short-term averaging periods (24 hours of less) are calculated by dividing the annual actual emissions by the number of hours of operation per year.

## II For PSD increment tracking:

- (a) All sources affecting PSD increment (defined in Subdivisions 22a-174-3 (k) (5) and 22a-174-3 (k) (6) of the Regulations) which lie within the radius of significance of the subject source for the applicable pollutant.
- (b) All sources affecting PSD increment with actual stack emissions of  $\geq$  50 TPY that lie within 20 km of the subject source.
- (c) All sources affecting PSD increment with actual stack emissions of  $\geq$  500 TPY that lie within 50 km of the subject source.

All PSD increment consuming sources retrieved above should be modeled with their maximum actual emission rates appropriate for the averaging period of concern, except that all increment consuming sources on the applicant's premise should be modeled with allowable emission rates. The maximum actual emission rates for short-term averaging periods (24 hours or less) are generally approximated with the allowable rates unless a source monitors this information and provides it to DEP. For annual averages, actual emissions are estimated from annual fuel use provided by sources to DEP. In addition to the inventory provided by DEP for PSD increment modeling, the applicant must explicitly address the effects of area-wide emissions growth on increment consumption when modeled concentrations approach the available increments.

No radius searches are performed for  ${\tt CO}$  or  ${\tt Pb}$  sources. The impacts from local sources of  ${\tt CO}$  and  ${\tt Pb}$  are assumed to be included with the background concentrations.

#### 5.3 METEOROLOGY

The meteorological parameters required by Gaussian air quality models are hourly estimates of wind direction, wind speed, ambient temperature, mixing depth and stability class.

### 5.3.1 METEOROLOGY FOR SCREENING MODELING

When the ISCST model is run in the screening mode, the 20 meteorological conditions found in Table 5-2 should be used to determine worst case impacts. In addition, the ambient temperature should be set to  $293^{\circ}$ K and wind direction should be selected such that the receptors are directly downwind from the subject source.

The set of 17 meteorological conditions listed in Table 5-3 should be used when running the PTMTPA-CONN model in complex terrain. Ambient temperature should be set to  $293^{\circ} K$ . wind directions are automatically determined by PTMTPA-CONN.

#### 5.3.2 METEOROLOGY FOR REFINED MODELING

Meteorological data for refined modeling must be representation of wind flow and dispersion characteristics that affect source emissions. Site-specific data are always preferable to off-site data for modeling dispersion near a source. Generally, one year of hourly site-specific meteorological data is considered the minimum requirement for dispersion modeling, but applicants are encouraged to use up to five years of data to adequately characterize year-to-year meteorological variability. EPA's meteorological monitoring guidance (EPA, 1986, 1987c and 1989) should be followed in designing and operating a site-specific meteorological monitoring program.

For many situations in Connecticut, off-site meteorological data measured from National Weather Service ()NWS) stations can be considered reasonably representative for dispersion modeling purposes. In such cases, DEP recommends the use of five consecutive years of hourly meteorological data. For sources

TABLE 5-2

20 METEOROLOGICAL CONDITIONS USED IN SCREENING MODELING WITH THE ISCST MODEL

STABILITY CLASS	WIND SPEEDS USED FOR STABILITY CLASS (m/sec)	MIXING HEIGHT USED FOR STABILITY CLASS (METERS)
A	1,3	5000
В	1,2,5	5000
С	1,3,5,10	5000
D	1,3,5,10,20	5000
E	1,3,5	5000
F*	1,3,5	5000

<sup>\*</sup>F stability is not modeled if subject source is in an urban area

TABLE 5-3

17 METEOROLOGICAL CONDISIONS USED IN PTMTPA-CONN MODELING

STABILITY CLASS	WIND SPEEDS USED FOR STABILITY CLASS (m/sec)	MIXING HEIGHT USED FOR STABILITY CLASS (METERS)
A	2.5	1800
В	2.5,4	1200
С	2.5,4,6,8,10	1200
D	2.5,4,6,8,10	950
E	2.5,4	700
F*	2.5,4	700

<sup>\*</sup>F stability is not modeled if subject source is in an urban area.

located within ten miles of the Connecticut coast, 1970-1974 data from the NEW station at Bridgeport Municipal Airport in Stratford may be considered representative and, if so, could be employed. At other locations (more than ten miles from the coast) 1970-1974 data from the NWS station at Bradley International Airport in Windsor Locks may be reasonably representative and, if so, could be used.

Applicants should discuss meteorological data requirements with DEP and obtain approval for the use of either site-specific or off-site meteorological data before any modeling is preformed. In some cases, such as for large sources subject to complex terrain complications, preconstruction monitoring of site-specific meteorology may be required.

#### 5.4 RECEPTORS

Receptor data needed by air quality models are defined by elevation and horizontal location relative to source locations. This information is normally obtained from U.S. Geological Survey 7.5 minute topographic maps.

Refined modeling of stationary sources relies on a receptor grid of sufficient detail to ensure compliance with AAQS and PSD increments within the significant impact area of the subject source. DEP recommends that applicants follow a two step procedure, beginning with an ISCST screening application followed by refined single source modeling to define a receptor grid to meet these objectives for multiple source modeling (described below).

#### 5.4.1 RECEPTORS FOR ISCST SCREENING

In this step, ISCST is applied to obtain hourly impacts for the set of meteorological conditions in Table 5-2 to determine distances to maximum impacts. Receptors should be placed downwind along a single radial, spaced at 100 meter intervals to 2 km, 500 m intervals to 10 km and at 1 km intervals to 20 km. Building downwash parameters should be included if the stack height is less than GEP and additional receptor should be placed at a downwind distance of 3L

### 5.4.2 RECEPTORS FOR REFINED SINGLE SOURCE MODELING

A grid of receptor rings is developed using the following procedure:

- 1) Identify the distance to the highest concentration listed in the ISCST screening output for each stability class. Select the smallest of these distances as the first receptor ring. For sources subject to building downwash, this distance should not be less than 3L, where L refers to the controlling building dimension in the GEP stack height formula (EPA, 1985).
- 2) Multiply the first ring distance by 1.33 to obtain the second ring distance (a minimum ring separation of 100 meters is adequate for most sources). Continue computing ring distances by multiplying the previous ring by 1.33 until the ring distance is reached for which all screening impacts are insignificant. This value is the final ring distance, which should never be less than 900 meters.
- 3) In some instances it may be desirable to locate receptors at the premise boundary. Additional receptor rings or discrete receptors may be needed for this.

A polar coordinate network of concentric receptor rings is set up, centered about the subject source, with one ring for each ring distance chosen. On each ring, thirty-six receptors are spaced at  $10^{\circ}$  intervals (from  $10^{\circ}$  to  $360^{\circ}$ ).

The elevation selected for each receptor should be the greatest terrain elevation in the area surrounding the receptor. This area is defined as the area half-way between the receptor ring and the two adjacent rings, bounded by two azimuths located  $\pm$  5 from the azimuth of the receptor. This method of choosing receptor elevations will generally give a worst-case impact for the area near the receptor. Elevated highways and bridges should be considered when determining the highest elevation in the area surrounding the receptor and should be denoted as "flagpole" receptors when a model provides this option.

Additional receptors may be needed to adequately define the impact area. For example, discrete receptors should be defined for elevated terrain beyond the last ring distance. Also, if single source refined modeling indicates concentrations on the farthest ring exceed the appropriate significance level, the additional receptors or rings will be needed to define the significant impact area.

Receptors need not be placed on the subject source's property if it is not accessible to the general public. A property is considered not accessible to the general public if it is surrounded by a physical barrier designed to prevent access by someone other than an employee (e.g., a chain link fence, guards, etc.). However, receptors should be placed on neighboring company property, even if the public does not have access to it.

### 5.4.3 RECEPTORS FOR MULTIPLE SOURCE MODELING

The receptor network developed for single source modeling should also be used for multiple source modeling, although receptors beyond the pollutant-specific, significant impact area of the subject source need not be included. Additional receptors should be chosen in areas that may be affected by multiple source lineups.

If the modeled results predict an unacceptable air pollutant concentration at an elevated receptor in the polar coordinate receptor grid, additional modeling should be performed using actual elevations with additional receptors located at prominent terrain features in each of the four surrounding sectors.

#### 5.5 BACKGROUND AIR QUALITY

Background air quality levels are added to modeled impacts to determine compliance with AAQS and PSD increments. DEP recommends using the most representative, nearby monitored data to estimate background levels. The DEP monitoring network is adequate for many permit situations in Connecticut. However, DEP may require an applicant to perform preconstruction monitoring for some pollutants if existing DEP-monitored data are deemed nonrepresentative. This determination will be made on a case-by-case basis following EPA monitoring guidance (EPA, 1987b).

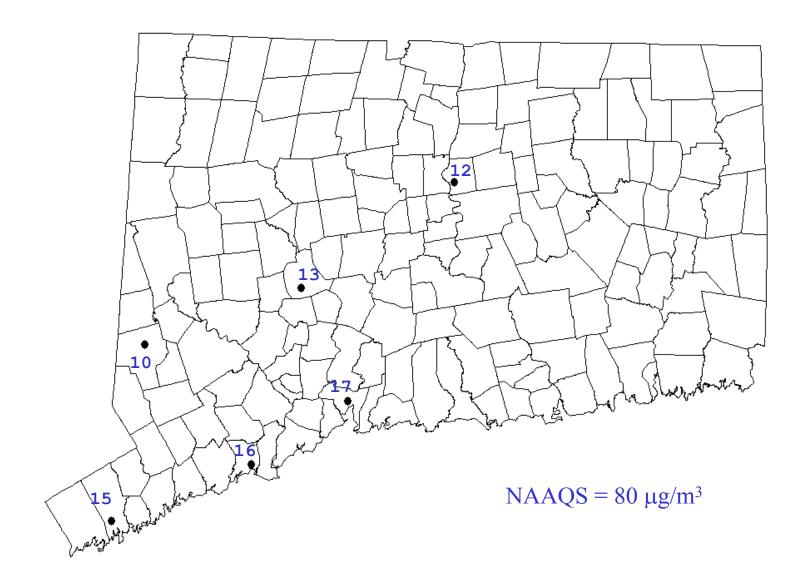
DEP's recommendations for estimating background concentrations from DEP monitoring sites that are deemed representative for a given application are summarized in this section. Figures 5-1 through 5-6 provide examples of how DEP plans to provide data for regional background air quality levels to permit applicants. Data in these figures will be updated annually by June 30 to reflect the most recent 3 years of measurements. Permit applicants should contact DEP for the most recent data.

If the significant impact area of the subject source extends across the Connecticut line, the applicant should obtain monitored data from EPA, or the state in which the impact would occur, to establish background concentrations for the out-of-state impact area.

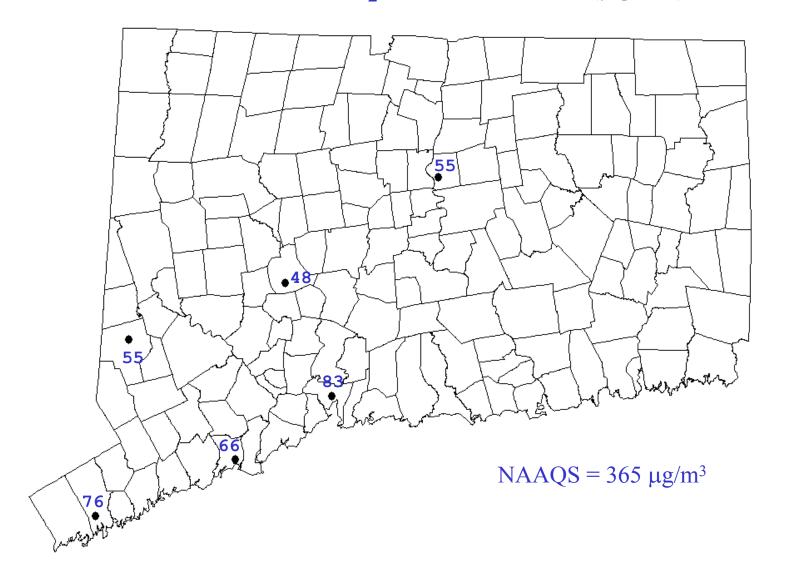
#### 5.5.1 SULFUR DIOXIDE BACKGROUND

If the most recent  $SO_2$  concentrations measured by DEP are deemed representative, they can be used to define background levels. Example DEP  $SO_2$  data for the three year period 1985-1987 are displayed in Figures 5-1, 5-2 and 5-3 for the annual, 24-hour, and 3-hour averaging times, respectively. The annual data (Figure 5-1) are averages of annual means at each site for the 3-year period. The 24-hour and 3-hour data (Figures 5-2 and 5-3) are averages of the second highest measured values for each of the three years at each site.

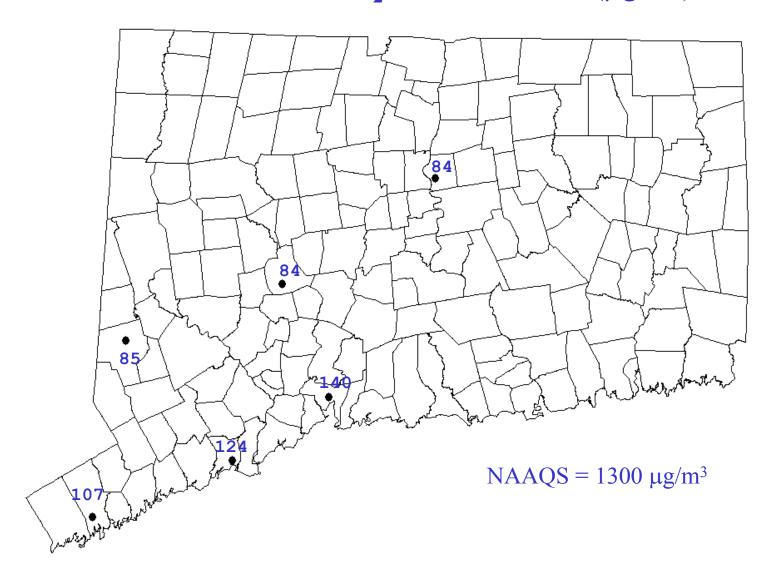
# 1999-2001 Average Annual Monitored SO<sub>2</sub> Concentrations (μg/m<sup>3</sup>)



# 1999-2001 Average 24 Hour Second Highest Monitored SO<sub>2</sub> Concentrations (μg/m<sup>3</sup>)



# 1999-2001 Average 3 Hour Second Highest Monitored SO<sub>2</sub> Concentrations (μg/m<sup>3</sup>)



DEP recommends that, if existing representative  $SO_2$  background levels for a given application are used, they be defined as the average of the second highest (or annual) values(s) from the three DEP monitoring sites located nearest to the source.

#### 5.5.2 PARTICULATE MATTER BACKGROUND

Impact assessments are currently made for two measures of particulate matter: TSP and PM10.

Example DEP TSP data for the period 1985-1987 are shown in Figure 5-4 (3-year average of the annual geometric means) and Figure 5-5 (3-year average of the yearly second highest 24-hour averages). DEP recommends that, if representative, particulate matter background levels be defined using the same procedure used for  $SO_2$ , above (average of the second highest or annual values at the three nearest sites).

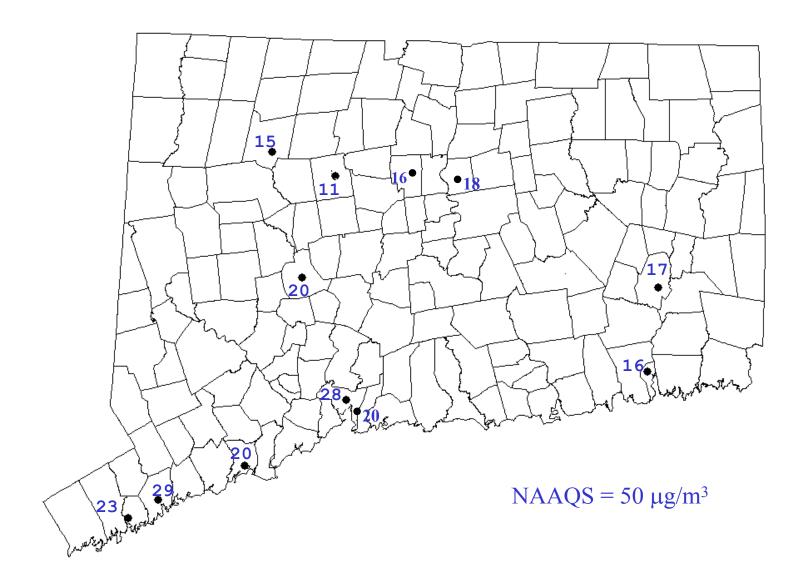
In mid-1988 DEP discontinued monitoring TSP and began monitoring PM10 on a state-wide basis. Sites in Bridgeport, Hartford, New Haven, Waterbury and West Haven have a complete 3-year period of record available through 1988, but the other sites need to be operated for a full year before PM10 background levels can be established. In the interim, DEP recommends that permit applicants who use representative DEP-measured particulate matter data for PM10 do the following: use TSP data as a surrogate measure (one-for-one) for incomplete PM10 periods of record until a full year of PM10 data is available.

In addition, a localized area of PM10 concentrations above the AAQS was measured in 1987 at a special purpose monitor located at Stiles Street in New Haven. This area will be treated as nonattainment until the observed PM10 levels are reduced below the AQQS. Until that time, permits will not be granted for new sources or modifications that significantly impact this area.

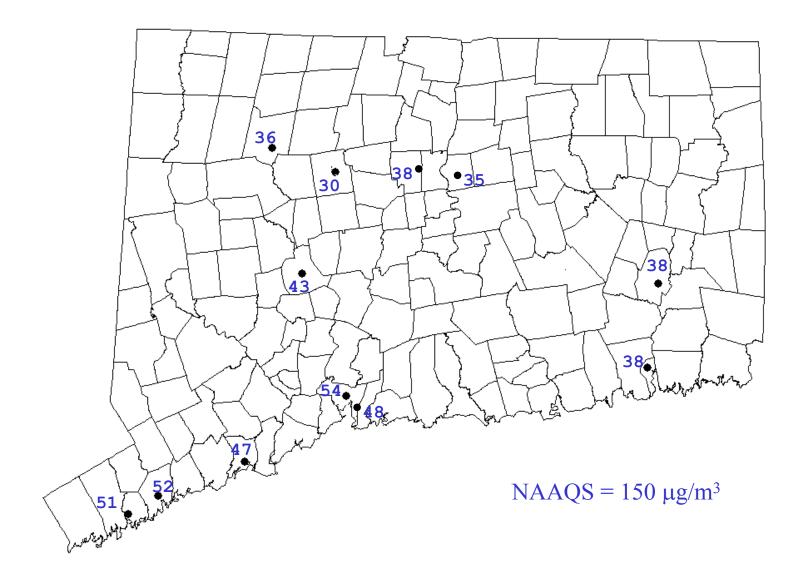
### 5.5.3 NITROGEN DIOXIDE BACKGROUND

As shown in Figure 5-6, DEP maintains three  $NO_2$  monitoring sites, located in Bridgeport, New Haven and East Hartford, to estimate annual average  $NO_2$  concentrations. If representative existing data are to be used, DEP recommends using the average  $NO_2$  concentration from these three sites as a conservative estimate of state-wide  $NO_2$  background levels. For the three year period 1985-1987, the statewide  $NO_2$  background concentration from this technique was 50  $ug/m^3$ .

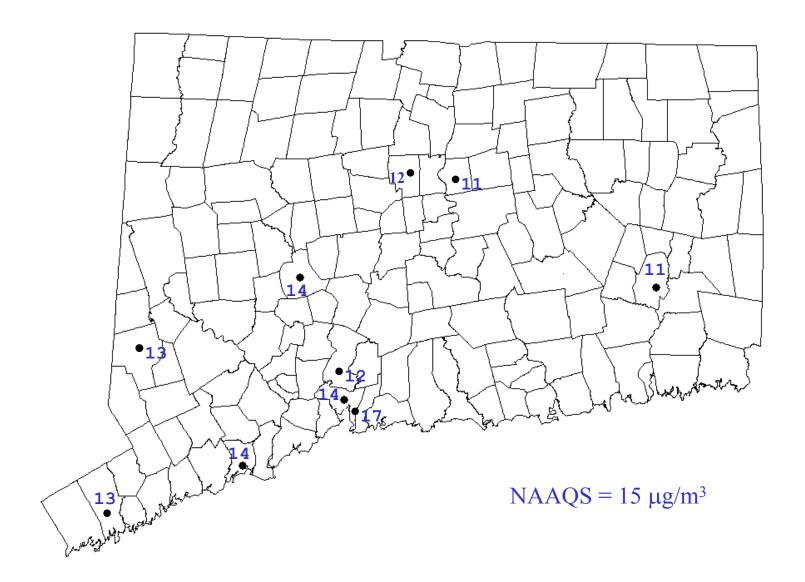
# 1999-2001 Average of Mean Annual Monitored PM10 Concentrations (μg/m³)



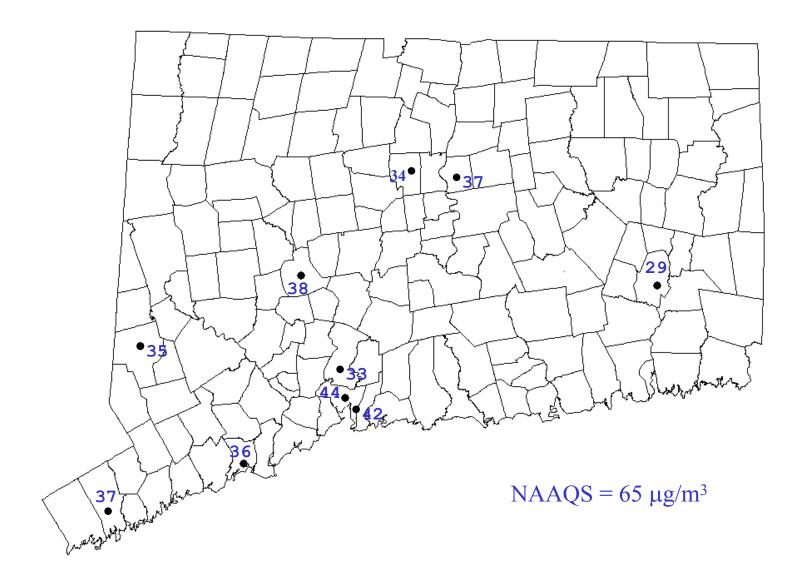
# 1999-2001 Average 24 Hour Second Highest Monitored PM10 Concentrations (μg/m³)



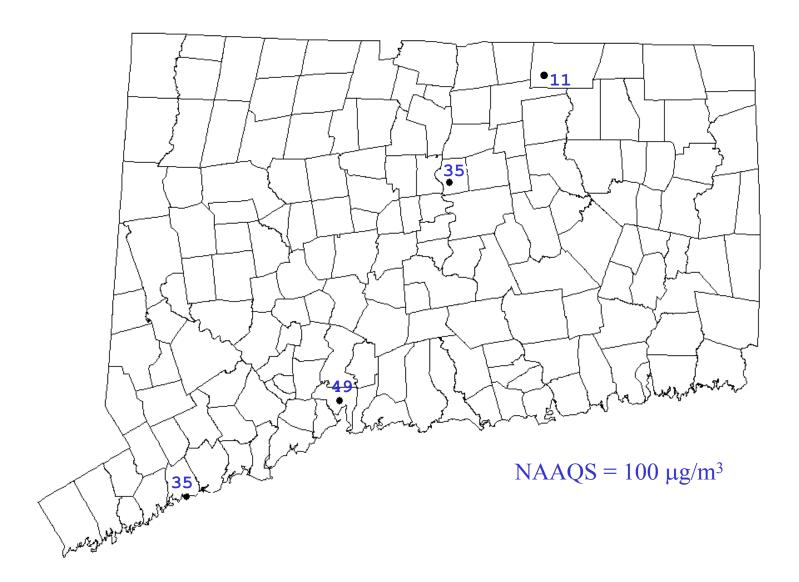
# 1999-2001 Average of Mean Annual Monitored PM2.5 Concentrations (µg/m³)



# 1999-2001 Average 24 Hour Second Highest Monitored PM2.5 Concentrations (µg/m³)



# 1999-2001 Average Annual Monitored NO<sub>2</sub> Concentrations (μg/m<sup>3</sup>)



#### 5.5.4 CARBON MONOXIDE BACKGROUND

CO emissions are generated by both stationary and mobile sources, but localized "hot-spots" of elevated CO concentrations are nearly always related to traffic congestion during urban rush-hours. DEP's CO monitoring network is designed primarily to track CO levels at these hot-spots. CO levels in most of Connecticut are less than 50% of the AAQS. As a consequence, DEP recommends the following policy for CO background in stationary source impact assessments:

- 1) show that CO impacts from the subject stationary source are insignificant at high volume urban intersections where elevated CO levels are likely,
- 2) elsewhere use 50% of the AAQS as an estimate of Co background levels state-wide.

#### 5.5.5 LEAD BACKGROUND

There has been a general downward trend in lead levels across the State over the last decade (CTDEP, 1988b). Therefore, a conservative 3-month average background of 0.75 micrograms per cubic meter, the maximum measured lead level in the State in 1984, should be used. An applicant may use an alternate value upon demonstration to the DEP that it is more appropriate.

### 5.5.6 HAZARDOUS AIR POLLUTANT BACKGROUND

Background levels for hazardous air pollutants regulated under Connecticut's hazardous air pollution program are expected to be quite low. For example, background levels for dioxin (currently the only hazardous air pollutant with an AAQS) have been barely detectable. DEP recommends that background levels for hazardous air pollutants be defined as one half of the AAQS for these pollutants until more data become available.

### 5.6 ANALYSIS AND INTERPRETATION OF MODELED RESULTS

#### 5.6.1 SHORT-TERM AVERAGES

Several of the AAQS and PSD increments are defined for averaging times for 24-hours or less (i.e., short-term averages).

The ISCST model will produce results for 1-hour, 3-hour, 8-hour and 24-hour averages. These values are compared directly to the PSD increments or added to background levels for comparison with AAQS.

PTMTPA-CONN produces results for 1-hour, 3-hour and 24-hour averages. The model internally uses the multiplying factor 0.9 to covert from a 1-hour to a 3-hour impact (Budney, 1977).

#### 5.6.2 LONG-TERM AVERAGES

Long-term averages are generally considered to be for periods of one month or more. AAQS and PSD increments currently exist for quarterly (3-month) and annual averages.

<u>Lead Quarterly Average.</u> The lead (Pb) AAQS is a quarterly (3 month) average. The highest 24-hour impact for a year may be used as a conservative estimate for the highest quarterly concentration for that year.

From five years of ISCST model results, quarterly averages can be calculated from the monthly averages. The largest of the quarterly concentrations is added to a lead background concentration for comparison with the AAQS.

For receptor locations above stack top, the PTMTPA-CONN model should be used as described in the User's Guide (CTDEP, 1988a) to determine worst-case 24-hour impacts. This value can be used as a conservative estimate of quarterly impacts. Another way to obtain the maximum quarterly impact using PTMTPA-CONN, is to multiply the highest 24-hour impact by the largest ratio of monthly to second-highest 24-hour impacts (not including background) from the ISCST model results for the same receptor. The largest of these values is then added to the lead background concentration for comparison with the AAQS.

Annual Averages. Annual average concentrations can be produced directly by the ISCST model for comparison with PSD increments or can be added to background levels for comparison with the AAQS.

To obtain the maximum annual impact using PTMTPA-CONN, multiply the highest 24-hour impact by the largest ratio of annual to second-highest 24-hour impacts (not including background) from the ISCST model results for the same receptor and pollutant. The largest of these values is then added to the appropriate background concentration for comparison with the AAQS.

# 5.6.3 COMPLEX TERRAIN

Both the ISCST and PTMTPA-CONN models should be used to estimate impacts at complex terrain receptors. The higher of the two estimated impacts as each receptor should then be used to determine compliance with the AAQS and PSD increments.

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